PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

NEW SERIES NUMBER THIRTEEN

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R R I

LOCATION. The Institute's Laboratories and Offices are at the third mile, Ampang Road, Kuala Lumpur.

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PUBLICATIONS. A list of 'Publications of the R.R.I.' is available on request. Subscription to Planters' Bulletin may be made by depositing $10 with us.

PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

Kuala Lumpur July 1954 Number 13

Editorial: Mechanisation

Cultivation is a treatment of temperate climate soils which is essential when preparing the land for planting or sowing crops, but as an agricultural procedure in the tropics it has accompanying disadvantages. The expression 'mechanical cultivation' is sometimes given a much wider meaning in Malayan agricultural circles, particularly in connection with rubber growing, where it may be taken to include the general use of major power units, with or without attached soil cultivation implements. We prefer to be more precise, and employ the term 'mechanisation' in this wider sense.

The extensive use during war operations of soil moving equipment, of which the bulldozer is one of the best examples, was the first introduction many of us had to the possibilities of using tractors on rubber estates. Shortage of labour and high wages, in comparison with the prewar rates, seemed to offer a suitable opening for any mechanised operations in Malaya during the immediate postwar period and bulldozers were used for felling and stacking old rubber trees and for clearing dense bush covers.

It did not take long for these early attempts at mechanisation to reveal many of the hidden snags attached to the operation of mechanical equipment. Breakages and repairs are inevitable, and if delays in working schedules are to be avoided, adequate supplies of spare parts and a competent and efficient machine repair service are essential. These desiderata have been difficult to attain, and for a satisfactory working procedure it has been found essential to have spare power units standing by. Idle equipment and technicians (*e.g.* skilled drivers) rapidly build up in the cost sheet unproductive expenditure items, to avoid which every effort should be expended.

These considerations have affected the economics of the operations, and any extensive mechanised clearing has been done either by contracting engineering firms who hire out and operate the necessary equipment, or by estate groups which are large enough and sufficiently centralised to afford the capital expenditure to purchase their own power units.

After mechanised clearing of an old stand, prior to replanting, the uprooted trees are stacked and left between the new planting rows. They may harbour rats which will maraud on the young rubber seedlings, and they create weeding problems, particularly if lalang begins to establish itself under the piled twigs and branches. The answer, although unpalatable to the soil scientist whose main aim in cultivated tropical soils is to build up organic matter, has been to burn the stacked timber. It is with considerable interest, therefore, that we present in this issue

an account of mechanised replanting which has been prepared by the manager of one of a group of estates which is planning extensive replanting operations and using mechanical equipment as widely as possible.

The cheapness of tree poisoning, which is the alternative method most commonly used for dealing with the old stand of trees, has been another factor detracting from mechanised clearing. It has still to be demonstrated whether elimination of trees by poisoning proves economical over a period of years and when the costs of future treatment of diseased trees and the sources of disease have been allowed for.

Light wheeled tractors have been acquired by a large number of estates and, by means of a range of attachments, used for soil cultivation, holing, weed eradication and control and general purposes. Under certain conditions higher powered machines have been effective in preparing wide contour planting terraces on sloping land, but a high degree of driving skill is required for this work. On flat land which requires draining, there is considerable scope for the employment of dragline excavators, either in cutting new drains or in clearing old ones.

Much has still to be learned about operating techniques of mechanical equipment under Malayan conditions and, in attempting to avoid excessive spells of idleness, the error may easily be made of working in wet weather and causing marked damage to the physical condition and properties of the soil. The problems of mechanical cultivation can only be solved by full scale field operations, and trial and error methods are the ones which must largely be employed.

Covers and Weeding

ALTHOUGH SOILS ARE PRODUCED FROM ROCKS by various processes of weathering and decomposition, a soil in the agricultural sense of the word is not merely a lifeless and inert mixture of various sized chemical particles of differing solubilities: it contains vital layers of organic material, giving rise to humus and sustaining micro-organisms, bacteria and fungi. Under jungle, the organic matter in the surface soil builds up, and may gradually increase. But when the ground is cleared for agriculture, and loses the protection of the tree canopy, the valuable organic layers begin to disappear.

In tropical agriculture, proper maintenance of this soil organic matter is often the key to success. With a permanent tree crop like rubber, the planter has to grow two types of plant — one for his crop and the other to maintain the organic layers of his soil. To strike the right balance calls for skill and judgement.

A long established association of jungle trees and undergrowth leads to a near-equilibrium in the cycle of growth and decomposition in the topsoil. The living plants build up their tissues by photosynthesis, out of water and nutrients from the soil, and of carbon dioxide from the air. The tissues are eventually decomposed at the soil surface by worms and insects, and by micro-organisms; carbon dioxide is liberated and nitrogen is stored in the soil as a bye product of bacterial activity.

Under jungle conditions, therefore, the decomposing remains of plants create a zone of accumulation at the surface of the soil, rich in mineral nutrients brought up through the roots from the various layers, and rich in organic products from synthesis in the upper parts of plants.

The benefits from cover plants, from organic matter and humus are:

1 Protection of the soil from direct action of sun and rain
2 Aeration and drainage of the soil — an open structure results from root decay and the movements of ants and worms
3 'Structure' is maintained — the decomposition products of plant residues help to stabilise aggregates of soil particles
4 Enrichment with mineral nutrients taken up from lower horizons
5 Fixation of nitrogen from the soil air by bacterial action.

Organic matter, and the microbial population which effects its decomposition, are therefore vital in any soil. How are they best maintained? Under tropical tree crops the organic plant residues necessary for the soil are most readily produced by growing a secondary crop or cover plant and allowing a natural cycle of growth and decay of this to provide the soil organic matter. The growing of two crops inevitably produces problems of competition, cover crop control, and selection of the most suitable plants to form the ground cover.

LEGUME OR NON-LEGUME?

The choice of cover lies broadly between a legume and a non-legume. Before 1941, old rubber areas due to be replanted were often sparsely covered, or else had only the poorer types of cover; there was no advantage in retaining these existing plant types. The replanting operations in many instances included complete digging of the area as a measure to reduce or eliminate future root disease. With relatively cheap labour costs and with seeds and fertilisers available at low prices, it became a standard practice in replanting to establish leguminous creepers, such as *Centrosema pubescens, Pueraria javanica, Calapogonium mucunoides.* Early postwar replantings often did not include the planting of leguminous covers, the change in policy being mainly economic, but practice has swung to using legumes once more as a ground cover.

There are numerous pros and cons to be considered when comparing legumes with non-legumes as covers in replantings or in any new plantings. The legume has the advantage that in the right environment bacteria in its root nodules may fix atmospheric nitrogen. Because of their higher nitrogen content and lack of woody tissues, leguminous creepers will decompose more rapidly in the soil than indigenous bush types of non-legumes. A legume creeper usually gives a dense protective covering to the soil which is equalled by few other species.

Differences between the two types of cover due to their competition with rubber plants have not been definitely established and are probably sufficiently small to be ironed out by methods of weed control.

The main criticisms against the use of legume creepers in young rubber are the cost of establishing and maintaining them and the impossibility of retaining them as an effective cover in all except very few

areas, when the rubber trees have reached maturity. Under the shade of foliage from closed-in branches of young rubber trees, legume creeping covers will invariably thin out and disappear, despite the use of fertilisers and earlier inoculation treatment of the cover seed with suitable cultures of *Rhizobia*.

It is inadvisable to establish a cover of pure legume creeper so that when it disappears, a bare soil is left on which other types of cover will grow with difficulty. Where the better indigenous covers exist, and where they are likely to establish themselves in a reasonably short time, these plants should be regarded as the permanent cover for the area. They should be encouraged and should not be eradicated and replaced by the more transient, though temporarily more luxuriant, legume creepers. Where legume creepers are planted in young clearings and replantings, combination with desirable species of indigenous plants should ensure the persistence of some helpful covers even when the rubber trees are giving their full shade to the ground.

A different viewpoint must be taken when the land carries undesirable covers which should be eradicated when the rubber trees are replanted. Lalang, bracken, stagmoss, Straits rhododendren, and many grasses, are covers which we should prefer to remove; whether this is done by spraying with a weedkiller or by cultivation of the soil, quick growing legume creepers are most effective for covering the bare ground as soon as possible.

The best methods for the establishment, maintenance and control of indigenous cover plants are discussed adequately in our manual *The Uses and Control of Natural Undergrowth* (2nd edition), from the practical point of view. This publication also contains a collection of some eighty full page plates for purposes of identification. The establishment of legume covers will be described in a forthcoming article in *Planters' Bulletin*.

WEED CONTROL

A number of the earlier postwar replantings have failed to introduce legumes as the principal ground cover and changed to the practice of retaining existing covers. Relatively little digging over has been done to remove rubber roots; the old trees have been poisoned and left standing, or else felled and the stumps poisoned. Under these conditions, particularly when avenue or hedge planting has been adopted, the chief cover problem has been grasses in the planting rows.

The traditional monthly treatment of weeds in the planting row, by hand and changkol, has become too expensive an item in the replanting budget, and estates have attempted to reduce weeding costs in a number of ways. Our recommendations appear under the heading COVERS AND WEEDING on page 122 of *Planters' Bulletin 9*. Circle weeding is regarded as false economy and bad practice, and strip weeding is much to be preferred.

Although growth will undoubtedly be retarded if weed control is reduced too early in the life of the young trees, the width of a weeded strip or terrace may be reduced after the first two years, or maintenance

may even cease on the assumption that the developing rubber roots have extended beyond the edge of the strip and into the cover crop area.

Often weedkillers can safely be introduced in place of hand weeding, provided the rubber plants are not too young and hence susceptible to damage from drifting spray. They can be used to control covers, particularly grasses, along the planting rows or to widen the controlled strip.

Little has been done to develop mechanical cultivation methods of weed control on rubber estates. This has been due partly to the limited extent of suitable terrain and also to the type of equipment available. Where hilly land necessitates terrace planting on contour and where the method of clearing produces surface logs and stumps, or where tree poisoning has been used as a replanting procedure, wheeled or tracked power units cannot be introduced. The small rotary hoe has been effective on flat alluvial clay soils both for checking the spread of creeping weeds into the planting rows and for producing a more friable top soil. But soil cultivators, such as ploughs, harrows and rotary hoes, are usually too drastic and should be reserved for eradicating undesirable covers, *e.g.* lalang, though a lightly set disc harrow will be economical for breaking down dense bush covers. On inland soils cultivating instruments are always liable to start erosion, and the most promising implement in this category is the Kedah roller which is ideal for checking Siam weed.

Hedge cutting machines which have been developed in other countries for trimming roadside hedges cannot be considered for replacing hand slashing of upright bush covers on rubber estates, because they require to operate from a reasonably smooth surface, planning for and creation of which would need to be done before rubber trees are planted.

What of the future of weed control on rubber estates? Hand labour is no longer a cheap commodity and modern large scale agricultural enterprises are turning to measures and procedures which require fewer men in their operation. The application of agricultural machines and implements in the upkeep and maintenance of rubber estates is limited to special operations, usually concerned with preparing the ground before planting.

There appear to be considerable possibilities for a greatly extended use of chemical weedkillers in cover crop control operations on rubber estates. These will occur principally in young areas where weed control problems are more urgent. To develop fully the use of chemical herbicides wider investigations are required on new weedkillers and on the reaction of individual plants to them. Ultimately one expects that a combination of weedkiller treatments will successfully check or eradicate all undesirable weeds on estates, and that the advantages of less labour requirements, no soil disturbance, and possibly cheaper costs, will lead to general adoption of chemical spraying procedures in place of hand control with cutting or scraping implements.

SOILS DIVISION

Mechanised Replanting

We have pleasure in presenting a further guest article on mechanisation: a factual account, with costs, by the Manager of Kempas Ltd, Devon Division

A PROPERTY AT MERLIMAU, MALACCA, of about 5,500 acres was intended to be replanted on a large scale, using two Caterpillar tractors (one D.4 and one D.8) for the heavy work until the whole estate was completed. In view of the drop in the price of rubber, however, the order for the larger machine (the D.8) was cancelled and it was decided for the time being to do just as much felling and clearing as the D.4 tractor was capable of tackling*.

To gain experience, and to obtain some yardstick for costing and timing the various operations of clearing and planting, an abandoned area of 45 acres was selected for trial. This area can only be described as having reverted to secondary jungle, and was interspersed with patches of heavy to sheet lalang. The lie of the land was normal undulating, rising to a short sharp peak in the centre. The old rubber, apparently planted about 1912-14, was in an advanced stage of dieback in this particular area. On the hill top growth was exceptionally poor, with girths only 20 to 24 inches, but on the normal undulations girths ranged from 30 to 40 inches, and nearing the ravine edges from 40 to 54 inches. The original planting was 20 ft × 20 ft and root disease had been negligible — there were only two small open patches — so that when felling commenced, the stand was about 85 to the acre.

The soil ranges from clay to clay loam over a laterite base throughout, with patches of laterite outcrop. The top of the hill was heavily eroded and bare of vegetation.

FELLING AND STACKING

The Caterpillar D.4 tractor arrived on the estate in June 1953 and work commenced after a week's 'running-in' and practice. Because of the density and height of the undergrowth, felling procedure had to allow for

i visibility to drivers;
ii a rough check on daily progress;
iii trees to be laid in straight lines as far as possible, to facilitate stacking afterwards.

The machine first went down the slope between two rows of trees, with its bulldozer blade lowered to ground level, so as to crush the heavy undergrowth. It was then reversed back up the slope and applied to the first tree on either side of the cleared strip, with its blade raised as far as possible. In this way the weight of the machine was brought to bear as well as the power of its engine. If the tree yielded to this pressure, the machine was reversed as soon as it began to fall, and was then moved forward with blade lowered to force the base of the tree, so that it came right out of the ground.

When a tree refused to budge with its first push, other methods had to be used, depending on its size. The machine was reversed and

* *The D.4 is not considered powerful enough for the job it had to tackle. The use of a larger machine would not necessarily mean a higher cost as it would doubtless deal with a larger area per day.*

Felling, using the bulldozer blade

the blade was lowered to push a ramp of earth up towards the tree. The additional height of application of the blade, raised again to its limit, then gave increased leverage and most trees yielded to this pressure. For trees much above average size the same method was employed, but first the machine was used with blade lowered to tear out the lateral roots all round the base of the tree.

When this whole area had been felled, the trees were stacked in windrows. It was then thought to be advantageous to scrape the felled belukar along with the trees and deposit this too in the windrows. But too much earth was deposited in doing this, so that the belukar and bracken *etc* became a sodden mass under the trees and the first attempt to burn off failed.

During stacking, the tractor was also used to fill in all deep contour drains, and to level off the gullies caused by years of erosion on the steeper slope of the hill.

Costs — The whole area of 45 acres was felled and stacked ready for burning off in 285 working hours. Two skilled drivers were employed on shifts of six hours. The total cost at this stage was $3,198 (Malayan), at an average cost of $11.22 per working hour, or $71.07 per acre. The cost per hour includes $4 for depreciation of the machine, and $4 reserve for future repairs and spare parts which, when they do become necessary, are rather costly. This method was thought to be reasonable in distributing these costs equitably over all items of work carried out.

RESTACKING AND BURNING

The first attempt to burn was made a month after the stacking was finished. As explained, it was a failure. This meant breaking up the windrows. Restacking was done by the D.4 tractor, assisted by a D.2; stacks were made as large as possible, clear of all debris. Meanwhile checkroll labour was employed to lop off all the smaller branches and to lay these around the butt ends. This made a nice compact stack and the burn off was most successful. When the stacks had burned right down the D.4 tractor spent 12 hours pushing the smouldering butt ends

together. With the addition of brush wood, these were completely burnt off.

Costs — The breaking up of the windrows and the restacking required 155 working hours, costing $1,566.58, or $34.81 per acre. The use of the D.4 tractor during burning cost $131.58, and the checkroll labour cost $261.40, totalling $392.98 for these two items, or $8.73 per acre.

TERRACING

The steep section of the hill, some 5 acres in extent, was pegged out in contours at an average separation of 20 feet. The D.4 tractor was used, with bulldozer angled, to cut terraces 8 to 10 feet wide. This was satisfactory where the subsoil was of a firm clay, and gave quite good terraces with a nice slope into the hill. Where the subsoil was of loose shingle, however, the terraces had no slope into the hill, because of the weight of the machine coming behind the blade. Moreover, the machine does not, of course, leave 'stops' at intervals along the terrace, so that after the first heavy rains there were serious breaks in the shingly area. Checkroll labour repaired these breaks and put in stops at intervals of 1 chain.

Costs — The D.4 tractor cut 161 chains of terraces in 12 hours work at a cost of $131.58, or 81.73 cents per chain. The checkroll labour cost $218.82, or $1.36 per chain. The total cost of terracing was thus $350.40, or $2.18 per chain.

LALANG ERADICATION

While the steep section was being terraced, the other 40 acres was ploughed and — where the lalang was heavy — crossploughed. A Fordson Major diesel tractor did this work, with a Krause triple disc plough hitched to the hydraulic lift. This was followed by discing and cross-discing over the whole 40 acres by a D.2 tractor pulling a 16 disc Rome plough. The final operation for eradicating lalang was done by a David Brown tractor pulling a cultivator.

Costs — The ploughing took 179 working hours and cost $423.26, or $10.58 per acre. The discing took 72 working hours and cost $325.85, or $8.15 per acre. The final operation with the David Brown tractor took 92 hours and cost $381.37 or $9.53 per acre.

In addition there was a total expenditure of $162.20 for the cost of labour on weeding and lalang up to the end of 1953.

EXPERIMENTAL PURPOSES

At this stage it should be explained that this selected area of 45 acres, besides giving an indication of costs as already described, was also intended for experiment on the following lines:

Planting material— half the area to be planted with clonal stumps from P.B. Further Proof seeds grown in the nursery to 10 months old, and half the area with ordinary seed at stake for budding with some of the latest proved clones.

Manuring programme — half the area using Sterameal in the planting hole to be followed by using complete fertiliser mixtures in the normal way, and half the area using rock phosphate in the

planting hole, to be followed by applications of sulphate of ammonia and rock phosphate only.

Square planting, 14 ft × 14 ft was decided upon — except of course for the terraced area, which was to be 20 ft × 10 ft — to facilitate future operation of wheeled tractors for cultivation, mulching or upkeep.

LINING, HOLING, PLANTING

Lining was carried out on contract at $3 per acre. At the same time germination beds were made and seeds laid out to germinate.

Holing was done by Ferguson tractor with the Ferguson post-hole digger, borrowed from an associate estate. Lack of familiarity and a leaky radiator made progress slow to begin with, and it took the driver two or three days to become expert at lowering the auger, to stop the swing dead on the peg. Eventually an average of 58 holes per hour was attained, boring to the full depth of the auger, roughly 3 feet deep.

Holing, using the Ferguson auger

Normally 60 to 65 holes an hour can be maintained with ease, depending on soil conditions, but here — the subsoil being laterite — the auger often struck stone or rock halfway down, and this meant one or two further attempts to get past. Under such conditions the cutter blades wore out rapidly and had to be replaced three times, during the digging of a total of 9,884 holes. The whole operation took 206 working hours, at an average of 48 holes per hour, and cost $533.71, on 5.4 cents per hole. With a skilled operator and no obstructions this work could be done for 4 cents, or rather less, per hole.

Planting — Checkroll labour followed immediately behind the tractor, filling the holes with topsoil and mixing in the manures. As weather conditions were ideal and time was pressing, planting was put in hand – both seed at stake and clonal stumps — and was completed by 24 December. Cover crop seed, of *Pueraria javanica,* was planted at the same time between the rows. Fortunately weather conditions continued favourably throughout January, so that both plants and covers got a good start.

SUMMARY OF COSTS

Details of costs of the various operations up to completion of planting, under the respective heads, are tabulated overleaf. The final column gives costs per acre averaged over the entire 45 acres (40 acres + 5 acres steep). The cost of planting material is excluded.

Mechanised Replanting

		Total	*Per acre*
FELLING AND CLEARING			
		$	$ c
Initial felling and stacking in windrows, 45 ac (D.4)		3,198	71.07
Breaking up windrows, restacking, 45 ac (D.4 & D.2)		1,567*	34.81*
Labour: lopping, burning		393	8.73
LALANG ERADICATION			
	$		
Ploughing (Fordson)	423		
Discing (D.2)	326		
Cultivator (David Brown)	381	1,130	25.11
Cost per acre over 40 acres = $28.26			
Labour: weeding		162	3.60
TERRACING			
	$		
Terracing, 161 ch (D.4)	131		
Labour: repairs	219	350	7.79
Cost per chain $2.18			
LINING, HOLING, PLANTING			
	$		
Cutting bamboo pegs	30		
Lining	129		
Holing, 9884 holes (Ferguson)	534		
Labour: filling in, planting	471	1,163	25.86
COVER			
Pueraria javanica			
	$		
Seed, 85 lb	271		
Rock phosphate, 2000 lb	120		
Labour	187	578	12.84
MANURING			
	$		
Sterameal planting hole mixture, 30 cwt	406		
Rock phosphate, 1200 lb	72		
Labour: transporting and mixing	111	589	13.09
TOTAL COSTS		$9,130	$202.91

* *This item is extra to normal procedure, so that costs to completion of planting may normally be expected to be about $170 per acre by the methods described.*

W. MURRAY

Quality of Latex Concentrate

In a communication shortly to be published in the *Journal of the R.R.I. of Malaya,* A.S. Cook and K.C. Sekar discuss 'Volatile Acids and the Quality of Concentrated Natural Latex'. The quality of concentrated latex is usually indicated by the volatile fatty acid number (VFA No.), the potassium hydroxide number (KOH No.) and the mechanical stability. Volatile acids are the products of putrefactive degradation in the latex and may be taken as a rough measure of the degree to which putrefaction has occurred. Putrefaction leads to chemical changes in the latex and prevents the normal increase in mechanical stability on storage; high contents of volatile acids and low mechanical stability thus go hand in hand. This was markedly demonstrated in one latex when with a VFA No. of 0.02 a mechanical stability value of over 2,000 seconds was reached after six months' storage, whereas with a VFA No. of 0.21 the mechanical stability remained constant after three weeks at values about 300 seconds. Low grade concentrate with a high VFA No. can be purified by diluting with water and reconcentrating.

With adequate ammonia content, the VFA No. of concentrate remains sensibly constant during storage and the main source of development of volatile acids is in the field latex. Scrupulous cleanliness during collection and treatment must be maintained. The time of ammoniation affects the development of volatile acids and the period of storage allowable before centrifuging depends on the ammonia content of the field latex. As a rule it is preferable to centrifuge the field latex within twentyfour hours of collection. It is shown that mixing old ammoniated field latex with freshly collected material has a deleterious effect on the quality of the concentrate.

Manuring of Young Mature Plantings

Some provisional conclusions on the value of manuring during the early years of tapping may be advanced, pending final results. These are based on observations of a number of experimental plantings established on estates throughout Malaya in the years 1937 to 1940. The data for 1953 are now subject to statistical analysis, and after this a full interim report will appear in the *Journal of the R.R.I. of Malaya.*

Manuring during the first three years after planting had a marked effect on growth in the early stages, due mainly to phosphate and to a lesser extent to nitrogen. The addition of potash appeared to be relatively unimportant. No manuring was done between 1941 and 1947. The first postwar girth measurements taken in 1946 or 1947 showed that trees early treated with phosphate were still the larger. Response to potash was still not detectable.

Tapping commenced in the years 1946 and 1947 and the postwar manuring programmes for the different experiments started in the following year or later. Applications were made at intervals of two years; the majority of the experimental areas have received three applications while a few are due to receive the third application in 1954. Girths have been measured annually since 1947 and yields have

been recorded continuously for the past 4 to 6 years.

All things considered, the experiments indicate that for young mature rubber:

i No response to manuring is likely on coastal alluvial soils.

ii On inland soils, manuring in the first years of tapping may increase production during the first tapping cycle in some areas and not in others. In our series of experiments on these soils the proportion of areas which show no response to those where a beneficial effect has been established in this early period is roughly 4 : 1. It is to be noted that the trees in all areas were well grown and in full vigour when tapping commenced. The effect of this early manuring on yields later, when renewed bark is tapped, remains to be seen.

iii When there is a response to manuring during early tapping years, this is attributable to phosphate and nitrogen applications as a rule, and not to potash.

A safe recommendation for young mature rubber on most inland soils is therefore the application of nitrogen and phosphorus, either as a mixture, or separately in alternate years. In certain areas a complete fertiliser will be necessary and sometimes the addition of magnesium may be beneficial, but these are exceptional cases and will normally be recognised on inspection.

It is again emphasised that the results available now are by no means conclusive. Manuring is a longterm project and it will take many years to determine its full effect on rubber trees. The lack of response in the majority of mature areas in the first years of a manuring programme is not surprising, and was indeed observed before the war. The few exceptions then were backward, low yielding areas.

Dry Rubber Content of Latex

THE DETERMINATION OF THE DRY RUBBER CONTENT (d.r.c.) of latex is required during the production of latex concentrate and sheet or crepe rubber as a basis for the payment of tappers, as a guide to dilution prior to coagulation, and for a determination of the amount of dry rubber in field latex and concentrate for buying and selling purposes. Hydrometers — marketed as latexometers, simplexometers and metrolacs — are widely used for the first two purposes but it should be realised that they do not give an accurate estimate of d.r.c. They measure the density of the latex in which they are placed and the d.r.c. of the latex can be estimated because there is a relationship between density and d.r.c. Density of latex also depends on the density of the latex serum and the amount of diluting water added, factors which vary with different latices. Since hydrometers are calibrated within a certain density range, usually on the basis of a 35 d.r.c. latex diluted with water to 15%, the variation in latex composition can lead to considerable errors in the estimation of d.r.c. Hydrometers calibrated for fresh latex

cannot be used for ammoniated latex as the density/d.r.c. relationship is different.

The chee method is also used for the payment of tappers but this too is inaccurate. A standard dipper gives a volume of latex which is coagulated, dried and weighed on a Chinese dachang balance. The inaccuracy is introduced by the different volumes of latex obtained by different persons using the dipper, depending on the amount of latex which is allowed to drip from the outside of the dipper.

The only accurate method of determining the d.r.c. of latex, whether fresh or ammoniated, is by weighing a sample of latex, coagulating and drying under specified conditions, and weighing the dried coagulum. The d.r.c. thus obtained is a weight percentage of the latex. Methods have been issued by the American Society for Testing Materials and by the British Standards Institution; they are similar to each other and to the methods used by the R.R.I. for fresh and ammoniated latex. Our methods are given at the end of this article.

Sampling is important and each bulk of latex must be thoroughly mixed before sampling. Samples should be taken with a sampling device from the top, middle and bottom of each bulk. The three samples are then combined and thoroughly blended. At least a quart of this composite sample should constitute the test sample.

The total amount of dry rubber in a bulk of latex can be calculated directly if the weight of latex and the d.r.c. (% wt) are known. For example 10,000 lb of latex with a d.r.c. of 35 contains $10{,}000 \times \frac{35}{100}$ lb of rubber, that is 3,500 lb. If, however, the weight of latex is not known and the measurement is by volume, the calculation is more complicated. The volume will usually be measured in gallons and to calculate the weight of the latex the density or specific gravity must be determined and the weight of one imperial gallon of water at the temperature of measurement must be obtained from standard tables. Also the volume in gallons must be corrected to the temperature at which the specific gravity is determined, assuming that the coefficient of expansion of latex is 0.05% per centrigrade degree.

The formula used is as follows:

> Weight of dry rubber = d.r.c. (% wt) × number of imperial gallons at T° × specific gravity at T° × weight of one imperial gallon of water at T° where T° is the temperature at which the specific gravity is measured.

For example, supposing that the volume of a latex is 1,000 imperial gallons at 32°C, with a d.r.c. of 35.00, and the specific gravity measured at 29°C is 0.9771. The corrected volume of the latex is $1{,}000 - (1000 \times \frac{0.05}{100} \times 3) = 1000 - 1.5 = 998.5$ gallons. The weight of one imperial gallon of water at 29°C from standard tables is 9.972 lb and therefore:

$$\text{Weight of dry rubber} = \frac{35.00}{100} \times 998.5 \times 0.9771 \times 9.972 \text{ lb}$$

$$= 3{,}405 \text{ lb}$$

It is stressed that accurate methods of measurement must be used if an accurate determination of the amount of rubber in a bulk of latex is required.

R.R.I. METHODS FOR DETERMINING D.R.C.

Ammoniated Field Latex — Make sure that the sample is thoroughly representative of the bulk. Place between 25 ml and 30 ml of latex in a 50 ml conical flask. Close the flask with a cork and weigh to the nearest milligram. Approximately 25 ml of latex are then poured into an aluminium coagulating dish of about 11 cm diameter. The corked flask is reweighed and the difference between the two weighings gives the weight of latex taken.

Slowly add 250 ml of 0.5% acetic acid in five minutes, with constant swirling. Set aside the mixture overnight. Pick up coagulated latex particles with the main body of the coagulum, then roll the coagulum into a thin sheet on a sheet of aluminium with a bottle filled with water. Wash the coagulum, drain and dry overnight in an oven maintained at 70°C. Cool in a desiccator and weigh. Repeat the drying and weighing until the weight is constant to 1 mg or less.

Duplicate samples shall be run and shall agree within 0.2%. The average of the two determinations shall be taken as the result.

Calculate the dry rubber content as follows:

$$\text{d.r.c.} = \frac{\text{wt dry coagulum}}{\text{wt latex sample}} \times 100$$

Fresh Latex — The procedure is the same as for ammoniated latex, except that 150 ml of 0.5% acetic acid are used for coagulating the latex.

Ammoniated Concentrate — The procedure is the same as for ammoniated field latex, except that 10 gm to 15 gm of the sample are taken and diluted with 20 ml of distilled water.

CHEMICAL DIVISION

R.R.I. News

Consideration has been given to controlling lalang by biological means through introducing a suitable pest or disease, in the same way that a tunnelling caterpillar was used to destroy prickly pear which spread over many million acres of grazing land in Australia. In introducing a lalang pest or disease there would be a risk of its spreading to some other grass. As cereals are cultivated grasses and include the staple food of the country, any introduction would need to be conducted with the greatest care. Susceptibility tests would hardly provide an adequate safeguard, for a pest or disease can change its habits sufficiently to extend its activities to other plants. The position is that the introduction of an insect or a fungus attacking lalang is to be regarded as too hazardous.

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We are sometimes asked to recommend books on rubber planting, suitable for the general instruction of young planters or estate owners. The short answer is, regrettably, that there is none such which is up to date. A leaflet has been prepared by the library, entitled 'Scientific Methods in Estate Practice for Malaya: Introduction to Post-war Literature', and this is available on request.

Powdery Mildew

'MILDEW' IS ONE OF THE OLDEST WORDS in the English language for referring to a microscopic fungus, but to the student of fungi it has come to have rather a special sense. Mildews of the hop and the vine were two of the earliest plant diseases to come under scientific investigation. The growers distinguished between a powdery mildew and a downy mildew on both crops. They based their distinctions on the appearance of the leaf to the naked eye, but it was found that the difference was valid scientifically and the terms have come into regular use as the names of two well defined groups of mildew fungi.

Powdery mildews are common in the tropics. They are mostly species of *Oidium*. and are specified by a second name usually derived from the host upon which they are found. Thus the *Oidium* found on *Hevea brasiliensis* is named *Oidium heveae*. This *Oidium* is an important factor in causing the fall of immature leaves following refoliation after wintering. In Ceylon it is the sole cause and the word oidium has in consequence become widely used for the disease that brings down young leaf following wintering. The name is inappropriate in Malaya where *O. heveae* is only one of several agents responsible; we therefore refer to the post-wintering shedding of leaves as secondary leaf fall, whether it is brought about by *Oidium, Gloeosporium,* mites or thrips, alone or in association. The name we favour for an *Oidium* attack that is unassociated with secondary leaf fall is powdery mildew, which, in this sense, is merely a mild disease of shaded foliage. The usual host is the self sown seedling under mature rubber, but lower branches of mature trees may be affected. The characteristic appearance has not been found on leaves exposed to full sunlight. Its importance is less in the damage it does than in providing a source of infection all the year round. It is the source from which the large quantities of young leaves produced after wintering are invaded. *Oidium* as a cause of secondary leaf fall may bring down a leaf and yet be practically invisible to the naked eye; as powdery mildew it rarely causes defoliation but can be very conspicuous. The leaflet illustrated in *Figure 1* is covered with large white fungal colonies and yet is unharmed but for slight yellowing.

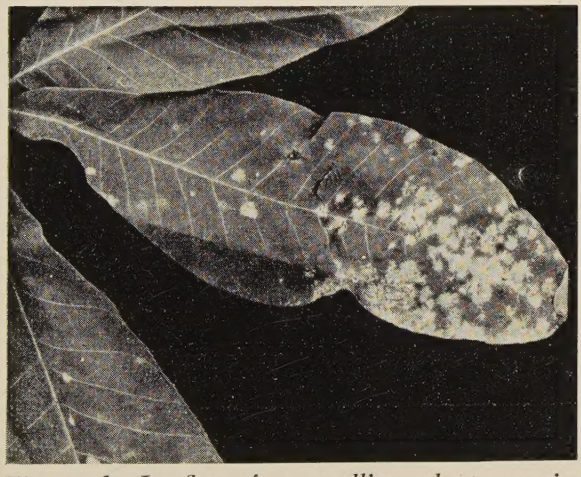

Figure 1. Leaflet of a seedling plant growing under shade, showing the form and distribution of Oidium colonies.

The fungus feeds by piercing the cuticle of the leaf at the numerous places over which its mycelium creeps; the mycelium does not grow into the interior of the leaf as does that of many other fungi. As well as the short processes which penetrate the leaf, the fungus produces large numbers of stalks bearing chains of thin walled spores (see *Figure 2*). They are readily blown away by wind and in this way alight on the leaves of other plants. If conditions are suitable and the leaf is at a susceptible stage the spore will germinate and start a new infection. Conditions are optimum when there is a high humidity in the neighbourhood of the leaf without standing water on the leaf surface. In wet weather the spore germinates without penetrating, and in dry weather it is killed by desiccation. The leaf is susceptible to attack throughout the shining brown and the soft green stages. After the hardening of the cuticle, simultaneously with the leaf rising to a horizontal position, it becomes resistant.

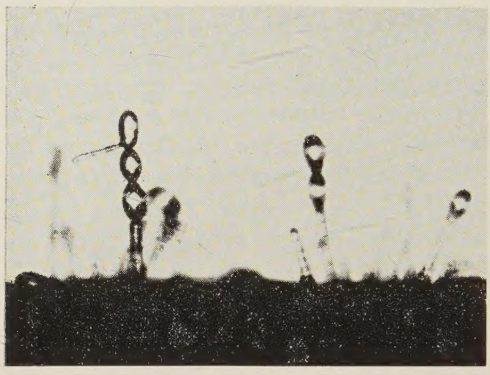

Figure 2. Photomicrograph of Oidium on the midrib of a leaf, showing details of a spore chain. The terminal spore is germinating.

Summarising, the fungus known as *Oidium heveae* may appear on mature trees as a cause of secondary leaf fall—rarely serious in Malaya—or as a powdery mildew on shaded leaves. The latter form causes insignificant damage but it is important as constituting a reservoir of the fungus.

PATHOLOGICAL DIVISION

Cleaning of Latex Equipment

The best method of keeping clean latex tanks, buckets, stirrers *etc*, is to wash off the liquid latex with water as soon as possible. Equipment can be disinfected by using a 1% solution of formalin and many brands of commercial disinfectants have been used with success. Equipment covered with a layer of dried rubber is difficult to clean even by vigorous scrubbing. Burning with a blowlamp is sometimes used and cleaning compounds containing alkalis have been suggested. Care should be taken that cleaning compounds and disinfectants do not contaminate the latex. Strong alkalis attack aluminium and alkali compounds should not be used with aluminium equipment.

Some Planting Manuals

LATEX PRESERVATION, CONCENTRATION AND SHIPMENT

A practical review of latex preservation and shipment as a commercial process, to assist producers contemplating entering the field. A survey of patents on latex preservation and concentration is included. Planting Manual No. 4 *By J.H. Pidford, second edition, 1947, $2.*

THE USES AND CONTROL OF NATURAL UNDERGROWTH ON RUBBER ESTATES

A consideration of the best methods for the establishment, maintenance and control of indigenous cover plants, copiously illustrated. An appendix classifies cover plants practically and contains about 80 full page drawings. Planting Manual No. 6. *Second edition being a revision of the original by W.B. Haines, 1940, $2.*

R.R.I. TYPE SMOKE HOUSES

The R.R.I's recommendations on the construction and operation of tunnel type smoke houses, based on a long series of experiments. With plans and bills of quantities. Planting Manual No. 9. *1949, $2.*

SOCFIN METHOD FOR "NAKED" BALING OF RUBBER

Full information, with illustrations and working drawings, of a method of baling sheet rubber which has been very well received by consumers overseas. Planting Manual No. 10 *By Socfin Company, 1951, $2 (only available in Malaya).*

These books are available from the R.R.I., P.O. Box 150, Kuala Lumpur. Planting Manuals Nos. 1, 2, and 7 are obsolete and out of stock, but we shall be pleased to pay $2 each on receipt of any unwanted copies of these publications in good condition.

R. R. I. Lectures to Planters

The following names should be deleted from the list for 1954, given on the back cover of our March issue: C.G. Akhurst, H.M. Burkill, A.S. Cook.

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